Application No.	:	09/481,803
Applicant	:	Avto TAVKHELIDZE
Filed	:	August 31, 1998
Title	:	Thermionic Vacuum Diode Device with Adjustable Electrodes
TC/A.U.	:	2834
Examiner	:	Karl IE TAMAI

Mail Stop Non-Fee Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Faxed: October 31, 2003

Fax No: (703) 746-4173

AMENDMENT

Sir:

In Reply to Telephone Conversation of October 30, 2003, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 10 of this paper.

FAX RECEIVED
OCT 31 2003
T.C. 2800

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): Apparatus for the conversion of energy comprising:

a) a source of energy;

b) an emitter electrode connected to said source of energy;

c) a collector electrode,

d) an electrical circuit connecting said electrodes; and

e) manipulating means for controlling the distance separating said electrodes, connected to either or both of said electrodes;

wherein said emitter electrode and said collector electrode each comprise a surface for positioning facing the other, wherein said surfaces are substantially flat and wherein minor topographical features of said emitter electrode surface match topographical features of said collector electrode surface.

Claim 2 (original): The apparatus of claim 1 further comprising housing means for said apparatus.

Claim 3 (original): The apparatus of claim 2 wherein said housing means is thermally conductive.

Claim 4 (previously presented): The apparatus of claim 2 wherein said housing is flexible to allow the movement of said manipulating means and of said electrodes.

Claim 5 (cancelled).

Claim 6 (previously presented): Apparatus for the conversion of energy, comprising,

a) a source of energy for promoting electron tunneling, and,

b) an emitter electrode, connected to said source of energy, and,

c) a collector electrode, positioned sufficiently close to said emitter electrode for electrons to tunnel from the emitter electrode to the collector electrode, and,

d) electrical circuit means, connected to said electrodes, for the circulation of electrons, and,

e) manipulating means for controlling the relative electrode positioning, connected to one or both of said electrodes, and

f) housing means for said apparatus, and

g) thermally conductive metal powder connected to said collector electrode for the transferal of thermal energy, and

h) an extendable depository for said metal powder, for providing room for the metal powder as the collector electrode is moved to the area previously occupied by the metal powder.

Claim 7 (previously presented): The apparatus of claim 1 further comprising measuring means to enable the measurement of the distance separating said electrodes.

Claim 8 (previously presented): The apparatus of claim 1 wherein said manipulating means is selected from the group consisting of: piezo-electric, electrostrictive, and magnetostrictive actuators.

Claim 9 (previously presented): The apparatus of claim 1 wherein said manipulating means comprises multiple actuators.

Claim 10 (previously presented): The apparatus of claim 9 comprising means for controlling said multiple actuators independently.

Claims 11-12 (cancelled).

Claim 13 (previously presented): The apparatus of claim 1, wherein the conversion of energy is the conversion of thermal energy to electrical energy, wherein said source of energy comprises a source of thermal energy, and wherein said apparatus further comprises:

a) a first thermal interface thermally connecting said source of energy to said emitter electrode;

b) a second thermal interface thermally connecting a heat sink means to said collector electrode;

c) an electrical load, electrically connected by said circuit between said collector electrode and said emitter electrode.

Claim 14 (previously presented): The apparatus of claim 13 wherein said source of thermal energy is of solar origin.

Claim 15 (previously presented): The apparatus of claim 1, wherein the conversion of energy is the conversion of light energy to electrical energy, wherein said source of energy comprises a source of photons, directed at said emitter electrode for impacting the electrons in said emitter electrode and for causing said electrons to tunnel to said collector electrode, and wherein said apparatus further comprises an electrical load, electrically connected by said circuit between said collector electrode and said emitter electrode.

Claim 16 (previously presented): The apparatus of claim 15 wherein said conversion of energy additionally comprises the conversion of heat energy to electrical energy and wherein said source of photons is also a source of thermal energy.

Claim 17 (previously presented): The apparatus of claim 1, wherein the conversion of energy is the conversion of electrical energy to heat pumping capacity, wherein said source of energy comprises an electrical power supply, and wherein said apparatus further comprises:

a) a heat source and a heat sink, wherein said heat source may be cooler than said heat sink, and wherein said heat source is thermally connected to said emitter electrode and said heat sink is thermally connected to said collector electrode, and,

b) means for applying a voltage bias to said electrodes for causing said emitter electrode to emit electrons originating from above the Fermi level via quantum mechanical tunneling, whereby heat pumping is enabled.

Claims 18-22 (cancelled).

Claim 23 (currently amended): A first and a second electrode for use in a thermionic diode device, each electrode having a surface for positioning facing the other electrode, wherein

said surfaces are substantially flat and wherein minor topographical features of one electrode surface match topographical features of the other electrode surface.

Claim 24 (original): A diode device, selected from the group consisting of: thermionic Power Chips, thermionic Cool Chips, thermo-tunneling Power Chips, thermo-tunneling Cool Chips, photoelectric Power Chips, and Gap Diodes, comprising the first and second electrodes of claim 23.

Claim 25 (original): The diode device of claim 24 wherein said electrodes are positioned closer than 200 angstroms from one another.

Claim 26 (previously presented): The diode device of claim 24 wherein the electrodes are positioned 100 angstroms apart or closer.

Claim 27 (previously presented): The diode device of claim 24 further comprising manipulating means for controlling the spacing between said electrodes.

Claim 28 (original): The two electrodes of claim 23 in which the electrodes have differing thermal expansion coefficients.

Claim 29 (original): The two electrodes of claim 28 wherein one electrode is for higher temperature operation than the other electrode, and said electrode for higher temperature operation has a lower thermal expansion coefficient than said other electrode.

Claim 30 (original): The two electrodes of claim 29 wherein the ratio of said thermal expansion coefficients is greater than four to one.

Claim 31 (previously presented): The two electrodes of claim 29 wherein said electrode for higher temperature operation comprises titanium.

Claim 32 (previously presented): The two electrodes of claim 29 wherein said other electrode comprises aluminum.

Claim 33 (previously presented): A method for making the pair of electrodes of claim 23 comprising the steps of:

a) providing a first electrode with a substantially flat surface fabricated from a first material;

b) coating said surface of said first electrode with a thin layer of a second material;

c) coating said layer of said second material with a layer of a third material, said third material forming a second electrode;

d) separating said first electrode and said third material from one another, in a manner non-destructive to said first electrode and said third material, wherein surface features of said second electrode match surface features of said first electrode;

e) removing said second material.

Claim 34 (original): The method of claim 33 further comprising the steps of:

a) positioning said electrodes less than 100 angstroms apart

b) adding an inert gas to the region between said electrodes to thermally insulate the electrodes from one another.

Claim 35 (previously presented): The method of claim 33 in which said second material is removed by a process comprising heating to a temperature greater than that of the melting temperature of said second material but lower than the melting temperature of said first electrode and of said third material, so as to evaporate said second material.

Claim 36 (previously presented): The method of claim 33 additionally comprising the steps of:

a) attaching said first electrode and said third material to controllable positioning means;

b) separating said first material from said third material in step (d) of claim 33 using said controllable positioning means, so that surface features on the surface of said first electrode are maintained in spatial orientation with said matching surface features on said second electrode.

Claim 37 (currently amended): A thermal insulator for thermally insulating two surfaces from one another, wherein said surfaces are substantially flat and wherein minor topographical features of one surface match topographical features of the other surface, comprising an inert gas enclosed in a gap of between 1 and 100 angstroms thickness between said two

surfaces, and further comprising a manipulating means selected from the group consisting of electroactive, magnetostrictive, electrostrictive, and piezo-electric means, wherein the manipulating means is connected to one or both of said surfaces and is for controlling the distance of the surfaces from one another.

Claims 38-49 (cancelled).

Claim 50 (previously presented): The apparatus of claim 7 wherein said measuring means comprises apparatus for measuring capacitance.

Claim 51 (previously presented): The apparatus of claim 7 wherein said measuring means comprises apparatus for measuring tunneling current.

Claim 52 (previously presented): The apparatus of claim 7 wherein said measuring means comprises optical interferometry.

Claim 53 (previously presented): The apparatus of claim 1 wherein said distance separating said electrodes is controlled at an initial value by said controlling means.

Claim 54 (previously presented): The apparatus of claim 1 wherein said distance separating said electrodes is 10 angstroms.

Claim 55 (previously presented): The apparatus of claim 1 wherein said distance separating said electrodes is 100 angstroms or less.

Claim 56 (previously presented): The apparatus of claim 1 wherein said distance separating said electrodes is 200 angstroms or less.

Claim 57 (previously presented): The apparatus of claim 1 wherein a region between said electrodes is evacuated.

Claim 58 (previously presented): The apparatus of claim 1 wherein a region between said electrodes comprise an inert gas.

Claim 59 (previously presented): The apparatus of claim 58 wherein said inert gas is argon.

Claim 60 (previously presented): The diode device of claim 26 wherein an inert gas fills a region between said electrodes.

Claim 61 (previously presented): The diode device of claim 27 wherein said manipulating means is selected from the group consisting of: electroactive, magnetostrictive, electrostrictive, and piezo-electric means.

Claim 62 (previously presented): The method of claim 34 further wherein said inert gas is argon.

Claims 63-64 (cancelled).

Claim 65 (previously presented): The method of claim 33 in which said second material is removed by a method comprising applying a vacuum to pump out any materials except said first electrode and said second material.

Claim 66 (previously presented): The method of claim 35 wherein said second material has a melting temperature approximately 0.8 of a melting temperature of said first material and said third material.

Claim 67 (previously presented): The method of claim 35 wherein said second material comprises lead.

Claim 68 (previously presented): The method of claim 35 wherein said third material comprises aluminum.

Claim 69 (previously presented): The apparatus of claim 1 wherein said distance separating said emitter electrode and said collector electrode is sufficiently small for electrons to tunnel from said emitter electrode to said collector electrode.

Claim 70 (previously presented): The apparatus of claim 13 wherein said distance separating said emitter electrode and said collector electrode is sufficiently small for electrons to tunnel from said emitter electrode to said collector electrode.

Claim 71 (previously presented): The apparatus of claim 15 wherein said distance separating said emitter electrode and said collector electrode is sufficiently small for electrons to tunnel from said emitter electrode to said collector electrode.

Claim 72 (previously presented): The apparatus of claim 17 wherein said distance separating said emitter electrode and said collector electrode is sufficiently small for electrons to tunnel from said emitter electrode to said collector electrode

Application Number 09/481,803
Amendment dated October 31, 2003
Reply to Telephone Conversation of October 30, 2003

Remarks/Arguments

Claims 1, 23 and 37 have been amended to more distinctly describe the invention. No new matter has been added. Applicant respectfully submits that this application, as amended, is in condition for allowance, and such disposition is earnestly solicited. If the Examiner believes that discussing the application the Applicant over the telephone might advance prosecution, Applicant would welcome the opportunity to do so.

Respectfully submitted,

Avto TAVKHELIDZE
Inventor

PTO/SB/21 (08-03)
Approved for use through 09/30/2003. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09/481,803
Filing Date	August 31, 1999
First Named Inventor	Avto TAVKHELIDZE
Art Unit	2834
Examiner Name	Karl IE TAMA)
Attorney Docket Number	

Total Number of Pages in This Submission: 11

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
- ☐ Fee Attached
- ☑ Amendment/Reply
- ☐ After Final
- ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts/ Incomplete Application
- ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
- ☐ After Allowance communication to Technology Center (TC)
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC (Appeal Notice, Brief, Reply Brief)
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please identify below):

Remarks

FAX RECEIVED
OCT 31 2003
T.C. 2800

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or individual name	Avto TAVKHELIDZE
Signature	
Date	October 31, 2003

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below.

Typed or printed name	Robert Flye		
Signature		Date	10/31/2003

This collection of information is required by 37 CFR 1.8. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.